

MEASURING AND MANIPULATING EPISTEMOLOGICAL BELIEFS

Measuring and Manipulating Epistemological Beliefs in Early
Childhood Education Students
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Abstract

Engendering sophisticated epistemological beliefs (beliefs about knowing and learning) in student teachers is a critical function of higher education. We report the preliminary results of a collaborative teaching unit and study examining the development of epistemological beliefs among early childhood pre-service teachers (N = 65). The program was unique in that it promoted sophisticated beliefs through explicit reflection on both personal epistemology and content related to research methods. Explicit reflection on the nature of beliefs about knowing and learning has been shown to impact on the development of students' personal epistemology. In this study, such reflection took place through tutorial discussions, practicum reflections and students interviewing critical friends about epistemological beliefs. Personal epistemology was also developed through a focus on research methods as the content of the course, which provided students with a first-hand experience of using evidenced-based knowledge – a key component of sophisticated personal epistemologies. Students were both the subject of, and joint researchers in the study. The program taught, and the study utilized, quantitative and qualitative research methods. Changes in epistemological beliefs were assessed pre- and post-test using Schommer's epistemological questionnaire. The results demonstrate the utility of explicit reflection and genuine experience in research pedagogy in developing sophisticated epistemological beliefs.

Measuring and Manipulating Epistemological Beliefs in Early Childhood Education Students

A growing body of evidence reflects the critical contribution of personal epistemology to academic performance (Baxter Magolda, 1994; Belenky, Clinchy, Goldberger, & Tarule, 1986; Fang-Ying, 2005; Perry, 1970; Wideen, Mayer-Smith, & Moon, 1998). A focus on epistemology is particularly important in educating student teachers, given their potential to influence the learning and development of children, and the ongoing effect it may have on their relationship with knowledge as they become adults (Bencivenga & Elias, 2003; Cano & Cardelle-Elawar, 2004). This potential becomes more crucial when educating the youngest children as they may be considered to have the most pliable, adaptive and vulnerable minds (Forbes, 2005; Langford, 2004; Odom & Wolery, 2003; Sandall, Schwartz, & Joseph, 2001; Young, 2004). However, while developing sophisticated epistemologies is central to the inquisitional aims of higher education programs in the humanities, this feature has typically been missing from programs in teacher education (Brownlee, Purdie, & Boulton-Lewis, 2001; Griffith & Benson, 1991; Schoenfeld, 1999). This report documents a novel, empirical approach to engaging, challenging and developing epistemological beliefs in pre-service early childhood teachers.

Realisation of the importance of epistemology in teacher education, and deficiencies in teacher education programs in developing meta-cognitive thought, has stimulated research interest in how to best develop mature epistemological beliefs. Perry (1970) and Belenky and her colleagues (Belenky et al., 1986) provided our first insight into the minds of higher education students as they progressed toward higher thought and meta-cognition. They suggested that higher education students progressed through orderly stages, from dualism or knowledge received, to multiplism or subjective knowledge, to relativism or procedural knowledge, and finally to commitment or constructionism. They assumed that this progression, while not obligatory, was unilateral and linear (see Brownlee et al., 2001 for a review).

Many developmental models since the 1970s have postulated similar pathways. However Kuhn and Weinstock's (2002) description indicates that epistemological beliefs develop from objectivist (reality is replicated), to subjectivist (multiplism) and then finally to evaluativism (knowledge that is personally constructed, critiqued, informed and evolving). Baxter Magolda (2004) demonstrated gender differences in the stages and character of epistemological development and Goldberger (1996) recognised that some ways of knowing may be culturally inappropriate and thus developmental pathways may not be universally accepted. Unilateral and linear development of epistemology did not fit these observations. It appears that our theories of epistemology struggle to keep pace with advances in human thought; this seems apt.

A new age in critical reflection on pedagogy and reflective practice commenced with Schommer's (Schommer, 1990, 1993, 1998; Schommer, Calvert, Gariglietti, & Bajaj, 1997; Schommer, Crouse, & Rhodes, 1992) use of multivariate quantitative methods to measure the nature and changes in epistemology. Her work revealed that epistemological beliefs were multidimensional. Factor analysis of Schommer's Epistemological Beliefs Questionnaire (EBQ, 1998) highlighted five dimensions on which beliefs about learning and knowing vary. These dimensions are the starting point for the current study and include:

1. Omniscient Authority (beliefs about the validity of the source of knowledge);
2. Certain Knowledge (beliefs about the reliability of knowledge);
3. Simple Knowledge (beliefs about the structure of knowledge);
4. Quick Learning (beliefs about the speed of learning);

5. Innate Ability (beliefs about capacity for learning; Schommer, 1990; Brownlee et al., 2001).

Schommer (1994) also suggested that a learner may simultaneously hold competing beliefs and thoughts, and that these might be represented along interdependent continua. For example, a person may hold predominantly sophisticated beliefs about the certainty of knowledge by believing that it is mostly evaluativistic, and yet, maintain the belief that a small amount of knowledge is absolute. Equally, a person with predominately naïve beliefs may consider that most knowledge is absolute, yet deem a little knowledge to be evaluativistic. Like Perry (1970), Schommer (1998a) recognized that a set of core beliefs may characterise “the learner’s default approach to learning and interpreting information” (p. 131). She designed her questionnaire to assess these dominant epistemological beliefs.

A multidimensional understanding of epistemological beliefs, along with the addition of quantitative methods to complement qualitative investigation, has provided the necessary tools to investigate the outcomes of epistemological focused interventions. Numerous studies have demonstrated that epistemological beliefs have an impact on teacher practice and student outcome (Beers, 1988; Hashweh, 1996; Kang & Wallace, 2005; Richardson, Anders, Tidwell, & Lloyd, 1991; Schommer, 1993; Schommer et al., 1997). Typically, students of teachers who reflect relativistic and constructionist beliefs and apply this in their practice, demonstrate more complex understandings of concepts, and are prone to critically evaluate and synthesise multiple knowledges and realities in relation to their construction of knowledge. It is this co-construction of knowledge, between instructor and instructed, that is posited as the zenith of developing a sophisticated personal epistemology and meta-cognition (Puntambekar, in press; Schellens & Valcke, 2005, in press).

Studies have demonstrated that including critical reflection and challenges to epistemological beliefs as part of teacher education generates more sophisticated thinking about knowledge and beliefs about knowledge, and that this flows on to more proactive and post-modern approaches to teaching and early childhood pedagogy (Brownlee et al., 2001; Gill, Ashton, & Algina, 2004; Schommer et al., 1997). Brownlee et al. (2001) implemented a teaching program with postgraduate education students that required them to reflect on their epistemological beliefs extensively throughout a year-long educational psychology unit. Students in the teaching program, as compared to a control group not involved in the program, developed more sophisticated epistemological beliefs and continued to maintain such beliefs over the first 2 years of their teaching experience (Brownlee, 2003). While evidence supporting the overt focus on developing sophisticated epistemology in pre-service teachers accumulates, few coursework subjects in education focus on epistemology, and very few do so through empirically valid methods (Brownlee et al., 2001; Gill et al., 2004; Schoenfeld, 1999; Wideen et al., 1998). To date, there are no published studies investigating the development of epistemological beliefs in education students through engagement in research and the co-construction of knowledge. Also, a search of educational and psychology databases reveal no studies examining epistemological beliefs in early childhood pre-service teachers (see also Wideen et al., 1998).

The aim of this study was both to provide a genuine experience in quantitative and qualitative research pivotal to the construction of teaching knowledge, while encouraging students to reflect on their own epistemological beliefs and those of their peers and other teachers, and to investigate changes in their beliefs over the course of the intervention. We predicted that participants’ epistemological beliefs would become more sophisticated, as demonstrated by the questionnaire, by the end of the semester. We hoped to demonstrate that

this brief, genuine research experience focusing on personal epistemology would compel change in epistemological beliefs. We also hoped that our project would produce similar results to the Brownlee et al. (2001) study of epistemological reflection which did not include a focus on research experience.

Method

Participants

Subjects (N = 65) were class members of an undergraduate coursework subject on research methods in early childhood. All participants gave written informed consent, and were permitted to withdraw or not submit their data at any time. All students were required to complete the questionnaire and the interview as part of the coursework experience. The class originally comprised 75 students. Ten students did not submit data or withdrew, or withdrew from the subject. The remaining sample of 65 comprised 60 females. Mean age was 24.87 years (SD = .92). Approximately 12% stated they had formal childcare qualifications and 69% stated they had childcare experience. Approximately 34% held post-secondary qualifications made up of 20% from a technical college and 14% from a university. Seventy four percent of the sample had no children of their own. As the study challenged personal beliefs, all participants were offered counselling if they became distressed. All class members were co-researchers in the study and were required to submit an empirical report for assessment. The Human Research Ethics Committee of the university approved the study.

The learning context

The research methods unit involved a novel approach to learning because it addressed both the development of more sophisticated personal epistemologies through explicit reflection and the development of research skills through authentic research experiences. Each will be discussed in turn with reference to one student's personal reflection on the learning context.

The development of personal epistemologies was promoted by (a) encouraging students to explicitly reflect on their beliefs and by (b) exposing them to a research culture that promoted evidenced based knowledge (a characteristic of sophisticated epistemologies). Explicit reflection on beliefs was promoted by having each student interview a critical friend about their beliefs and then submitting to be interviewed by their critical friend about their own epistemological beliefs. Further reflection was encouraged by requiring students to analyse their critical friend's beliefs and to write-up the results of these interviews in terms of the personal epistemology literature. Participants were exposed to multiple research paradigms and methods and were challenged to think critically about the literature on epistemology. Assessment of student outcomes was based on their submission of a report of the current study. This was done in two stages, to allow critical feedback and editing. Further, students were required to consider the epistemological beliefs of other teachers during their field experience and record these in a journal while on practicum in an early education setting. The following reflection demonstrates a student's perspective on the focus on epistemology throughout the unit:

The beginning of any semester fills a student with mixed feelings. Excitement, trepidation, and dread, add to the mix a new and untried unit and you may begin to understand how the student body felt. Looking back I'm sure most of us would laugh now knowing how much we gained from the unit considering that most of us had difficulties pronouncing

epistemology! So began our journey towards understanding and becoming researchers. The unit explicitly aimed to develop our personal epistemologies and research skills through hands-on experience. My fellow students and I will probably never forget what epistemology is or what Perry and Schommer did .(Drew Reeves)

Students were also encouraged to develop epistemological beliefs through exposure to the research culture. The students were co-researchers in the project and were encouraged to participate in discussion of research design and methods of analysing their data. Students were invited to participate in the writing of papers for publication and to share authorship. Some students were also invited to participate in conference presentations. This teaching method provided a genuine experience in research methods and how knowledge needs to be evidence based.

The development of research skills was the second learning outcome expected for the students. During the semester, participants were instructed on quantitative and qualitative research methods, validity and reliability, knowledge paradigms, and ways of knowing throughout lectures and tutorials. Instruction took the form of evidence-base learning by scaffolding them to develop their own research questions, hypotheses, and to evaluate the evidence. The following quote exemplifies students' need for scaffolding throughout this research process:

The process of doing research was I'm sure an eye opening and daunting prospect for most students yet doing the research was invaluable. Whilst it may have seemed a mountain of work the teaching staff broke it down without spoon feeding us. The first interview and EBQ questionnaire was we were informed 'blind' but carried out without blindfolds at dawn. We certainly felt blind and unsure. With the interview and transcription we realised how much work goes into research. Reviewing the literature and trying to sort the relevant from the irrelevant, and imposing some order on it was an interesting experience and lead to a deep processing of the information. (Drew Reeves)

Their research knowledge was also developed through direct involvement in a research study. In particular, participants were exposed to quantitative and qualitative research methodologies. Participants were not required to conduct or learn statistical analyses but were taught sufficient measurement theory to encourage critical reflection of the literature and an understanding of the terminology of descriptive and univariate inferential statistics. The following excerpt from the students' reflection on the unit demonstrates the level of stress associated with aspect of the research unit.

We were supported through the lectures where research theory and methodology were revealed a piece at a time. As our knowledge increased so too did our confidence until the statistics lecture. We had little prior exposure to statistics and most of us were flummoxed by the lecture, but it was amusing watching Phillip do his best. The hands on approach forced us to really engage with the research even if we were confused and unsure at times. I am sure that we improved over time. (Drew Reeves)

They were also engaged in qualitative research which required them to conduct a semi-structured interview with a classmate as described earlier. They were provided a list of standard interview questions (see Appendix B) and encouraged to use open-ended questions, summarizing, and checking questions. The interview was recorded on audiotape or digital media and later transcribed by the interviewer. Participants gave the recordings to the authors to

preserve integrity and they were later returned. The transcriptions were retained by the authors for analysis. The participants were also required to participate in a co-requisite practicum in early childhood and complete a daily journal reflecting on their experiences and epistemological beliefs.

Participants then submitted their assignment, which included a literature review on epistemological beliefs, a method section of a research report on the study they were participating in, quantitative and qualitative results and a discussion section. This assignment compelled critical reflection on both personal epistemology and research methodologies.

... when comparing the first interview with the second, even though the questions were basically the same as the first, I could see more of the interviewee's true thoughts revealed. The skill required to analyse the collected data was sadly lacking in most of us, I'm sure that most students would usually skip the analysis section in our readings as I do. However writing one really forces you to develop an understanding even if it is rudimentary. Whilst on field experience we reflected on our own and our host teachers epistemological beliefs and could see the link between beliefs and practice. Talking with other students after the field experience demonstrated this for me. Students in centres with thoughtful teachers observed thoughtful interactions with children whilst my teacher was concerned with order and I therefore observed an orderly classroom. Overall the unit could be likened to a gustation where we were introduced to the many and varied flavours of research without being filled by them. The unit achieved the aims of promoting sophisticated epistemological beliefs and developing research skills in a group of neophytes. (Drew Reeves)

Procedure and Apparatus

In the pre-test phase, participants attended an introductory lecture on the content and requirements of the unit. The study was then explained in very general terms in the first tutorial sessions and consent forms were signed and returned. Participants were blind to the study and hypotheses at pre-test, but were not misled.

Participants completed an online version of Schommer's (1998) epistemological beliefs questionnaire (EBQ) and a demographic survey, and printed and returned these to the authors for analysis. The EBQ has moderate test-retest reliability ($r = .70$, Schommer et al., 1997) and reasonable internal consistency (Cronbach's $\alpha = .63 - .85$, Schommer, 1993). Several studies have reported the validity of the EQB scales and subscales in predicting test performance (Schommer, 1990), interpreting information (Schommer et al., 1992), understanding and monitoring understanding (Schommer et al., 1992), perseverance on a difficult task (Dweck & Bempechat, 1983, cited in Schommer, 1993) and measuring belief change in student teachers (Brownlee et al., 2001). Students accessed the questionnaires via an online teaching website both on and off campus; access was restricted by student number and password. Some participants had difficulty accessing the site and were given equivalent hard copies to complete.

The post-test phase occurred nearing the end of semester. Using the same methods, participants again completed the EBQ and supplied a printed version to the authors for analysis.

Analyses

Schommer's (1998) method was used to condense the EBQ into the twelve primary subscales and the five secondary scales were then constructed according to Brownlee, Purdie and Boulton-Lewis (2001). The data from the time 1 and time 2 EBQ were then submitted to repeated measures *t*-tests to assess change in beliefs over the course of the intervention.

Results

All results were tested on a two-tailed distribution at the 5% level of significance. Group mean scores on the EBQ scales and subscales were compared between time 1 and time 2 using repeated measures *t*-tests. Some data was incomplete or unidentified and was excluded from these analyses without impacting the results. Figure 1 illustrates significant changes over the course of the intervention; decreasing scores represent more sophisticated beliefs. The group became more sophisticated in their responses on the EBQ on 1 scale and 5 subscales following the intervention. Participants' beliefs that learning ability is innate (Innate Ability) became significantly more sophisticated with the intervention, $t(51) = 2.62, p = .012$. Changes toward more sophisticated beliefs approached significance on the scales Quick Learning and Simple Knowledge, $t(53) = 1.89, p = .065$, and $t(51) = 1.88, p = .065$ respectively.

Increased sophistication in beliefs was observed on subscales Avoid Integration, $t(52) = 2.84, p = .006$, Knowledge is Certain, $t(53) = 2.09, p = .041$, Don't Criticise Authority, $t(53) = 2.77, p = .008$, Ability to Learn is Innate, $t(51) = 2.04, p = .046$, and Success Unrelated to Hard Work, $t(51) = 2.62, p < .001$. These results suggest that at the *belief level*, the group was more likely to integrate knowledge, less likely to believe knowledge is certain, less likely to believe learning is based on innate ability, more likely to criticize the authority of experts, and more likely to believe that success is related to hard work.

Discussion

Epistemological beliefs are diverse and multidimensional as described by Schommer (Schommer, 1998). The results clearly demonstrate significant changes in some epistemological beliefs over the course of the intervention. Generally, participants' epistemological beliefs became more sophisticated over the course of the semester. Although the mean differences are small, due to the scaling of the EBQ, they are considerable given the brevity of our intervention. Although the nature of the changes were somewhat different from those of Brownlee et al. (2001), we achieved these results in 12 weeks compared to 12 months. Particularly, our sample became significantly more sophisticated in their beliefs about the uncertainty of knowledge and importance of knowledge integration, that ability to learn is not necessarily innate and that success is related to hard work, and that expert authority should not go unchallenged. These findings should be of considerable interest to teacher educators, and have wide implications for tertiary education pedagogy.

Not all of the scales of the EBQ demonstrated significant change toward the more sophisticated, and those scales that were significant were different from those of Brownlee et al. (2001). Future research should aim to distill and explain these differences in terms of the sample characteristics, the methodological differences, and possible variance in the EBQ itself. However, it is a substantial finding of this study that, on a group level, no scale demonstrated a significant change toward the more simplistic level of epistemological beliefs. Beliefs were either unchanged or became more sophisticated. On the surface, our intervention involving genuine research experience, explicit reflection on beliefs about knowledge during practicum, combined with learning tasks that challenged knowledge and its authority succeeded in developing more sophisticated beliefs about knowledge and learning in this group of student teachers.

There are several limitations to our study. Our study was limited to early childhood preservice teachers and contains a diverse cohort of subjects, particularly older subjects with

technical college and childcare backgrounds, and our participants were mostly female, which may be representative of the profession. This limits its generalisability to other education students. We used a repeated measures design without a placebo control. Thus we cannot attribute cause only to our intervention. We cannot exclude the possibility that the changes observed would have occurred naturally over the course of the semester, although we believe this explanation to be very unlikely. Finally, while participants were blind to the study at time 1, they were intricately aware of, and invested in the research question and hypotheses by time 2. This was part of our experimental intervention. We cannot therefore say that participants were not affected by researcher bias, although our results were mild to moderate and there were no extreme shifts in beliefs to give cause for concern. Overall, our intervention involving direct reflection on epistemological beliefs and a genuine research experience appears to have had a significant effect on our early childhood pre-service teachers.

We recommend that educators consider the importance of genuine experiences in knowledge construction and of student reflection on personal beliefs about knowledge and its impact on pedagogy in developing ongoing student learning experiences in early childhood teacher education. Teacher educators may promote more effective learning by requiring pre-service teachers to explicitly reflect on the nature of their core beliefs about knowing. The effects of such meta-metacognition (metacognition about one's epistemological beliefs; Kitchener, 1983) and subsequent development of epistemological beliefs have been shown to impact on effective pedagogy (see Brownlee, 2003 and Brownlee & Berthelsen, 2004). Given current national concerns about the quality of practice in early childhood contexts, it seems that efforts to promote sophisticated personal epistemologies in pre-service teachers can only benefit teachers and children.

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Appendix A

Class EAB016

Bartholomaeus, Joanne Helen (Jo)

Bell, Katherine Ruth (Kate)

Blair, Kylie Maree

Boyd, Karen Gay

Bremner, Katrina Anna

Brown, Jillian Caroline

Brown, Tanya Leigh

Carey, Theresa Maree

Carn, Lauren Maree

Cooper, Kimberley Jennifer

Copper, Lorna Tiffany

Croft, Julia

Crombie, Tracy Anne

Cronk, Selena Ann

Dillon, Garrick Edward

Dixon, Jenna

Doyle, Josiephine

Dunn, Karina Faith

Dunn, Troy William

Erbacher, Ingrid Elizabeth

Fursey, Jessica Grace

Graham, Juanita Louise

Gribble, Megan Louise

Haagsma, Alida Lisse

Hancock, Amy Rebecca

Harder, Christine Elizabeth

Hare, Jemma Louise

Heuston, Michelle Ann

Hindle, Anna Patricia

Hughes, Trudy Lynette

Hunter, Ilena Sharon

Jasem, Christina

Johnson, Leanne Joy

Johnson, Sarah-Jane Ellen

Jones, Nicole Evelyn

Kato, Anne Sachiko

Keating, Emily Jayne

Kisaloff, Vikki Michelle

Le, Nga Hong

Liddell, Melissa Jennie

Lipp, Emma Louise

Maroske, Katlyn Rose

Martin, Miranda Clare

McDougall, Leith

Mulcahy, Kelly Jayne
Muraca, Jodie Lynne
Nissen, Jennifer Anne
Nothling, Jasmine Tennille
Olsen, Luana Jane
Perske, Karla Louise
Peters, Sylvia
Petrulia, Jennifer Anne
Pham, Phuong
Pirlo, Alisha Renee
Reeves, Drew Warren
Ryan, Chantel Maree
Smith, Nicola Leigh
Stanley, Kevin John
Stephens, Catherine Maree
Teevan, Sonya Bridget
Towning, Emma Susan
Uren, Elise May
Vandenbergh, Alicia
Walker, Sarah Louise
Wardle, Chloe Raithe
Warrell, Matthew James
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Author Note

We gratefully acknowledge the support of the School of Early Childhood, Queensland University of Technology, in funding this innovative project. The authors acknowledge the contribution of class EAB016 for their participation and contribution to the study. We acknowledge the assistance of the Practicum Coordinator Anne Petriwskyj and Senior Research Assistant Lyndal O’Gorman on this project.

Figure Captions

Figure 1. Change in EBQ over time (lower scores represent more sophisticated beliefs)

